CLAIMS

1. An anastomotic connector for connecting a graft to a target vessel, comprising:

a thin collar section, adapted to engage a portion of the graft; and

a separate spike section, adapted to mount on said collar section and comprising a plurality of spikes, each of said spikes adapted to transfix said graft.

2. A connector according to claim 1, comprising at least one locking element for interlocking said spike section and said collar section.

3. A connector according to claim 2, wherein said locking element is formed on said collar portion.

4. A connector according to claim 3, wherein said locking element mates with an aperture defined by said spike section.

5. A connector according to any of claims 2-4, wherein said locking element provides a spring-action, which action resists relative motion axial between at least part of said spike section and at least part of said collar section, with a force dependent on the range of motion.

6. A connector according to claim 1, wherein said spike section comprises a super-elastic material.

7. A connector according to claim 1, wherein said spikes are pre-bent in a hook shape, such that said hook shape is adapted to engage the target vessel.

8. A connector according to claim 1, wherein said collar element comprises a plurality of flange elements proximal to said target vessel.

9. A connector according to claim 8, wherein said flange elements define apertures for said spike elements to pass through.

10. A connector according to claim 9, wherein said flange elements include at least one opening in their perimeter, wide enough for one of said spikes to be brought in through.

11. A connector according to claim 1, wherein said collar section defines a cylindrical volume.

12. A connector according to claim 1, wherein said collar section is adapted to form a perpendicular anastomosis.

13. A connector according to claim 1, wherein said collar section is adapted to form an oblique anastomosis.

14. An anastomotic connector for connecting a graft to a target vessel, comprising:

a base for engaging said graft;

a plurality of spikes for transfixing said graft and engaging said target vessel; and

at least one spring element attached to at least one of said spikes, which spring element couples a connection between said spike and said base.

15. A connector according to claim 14, wherein said spikes and said base form a single element.

16. A connector according to claim 14, wherein said spikes and said base form two separate elements.

17. A connector according to claim 14, wherein said spring comprises a flat coil spring.

18. A connector according to claim 14, wherein said spring comprises a leaf spring.

19. A connector according to claim 14, wherein said at least one spring comprises at least two springs in series.

20. A connector according to any of claims 14-19, wherein, each of said spikes has at least one independent associated spring.

21. A connector according to claim 14, wherein said connector is configured for performing an oblique anastomosis.

22. A connector according to claim 14, comprising at least one tab associated with one spike of said spikes, for moving said spike.

23. A connector according to claim 22, wherein said tab is adapted for retracting said spike.

24. A connector according to claim 22, wherein said tab is adapted for advancing said spike.

25. Apparatus for delivering a graft to an anastomosis, comprising:

at least two tube-like elements, each defining an aperture adapted for inserting said graft such that the graft exits through a first end of said tube-like elements;

at least one separator element mounted on at least one of said tube-like elements for splitting the other of said tube like elements, so the graft can be removed through a resulting slot, which slot spans said first end and said aperture.

26. Apparatus according to claim 25, wherein said at least one separator comprises a knife which cuts said slit.

27. Apparatus according to claim 25, wherein said at least one separator comprises a spreader which widens an existing slit in said tube to form said slot.

28. Apparatus according to claim 25, comprising an outer tube which prevents said tube from splitting unless it is sufficiently retracted.

29. Apparatus according to claim 25, wherein said tube-like elements are adapted to carry an anastomotic device between them.

30. A method of removing a graft delivery tool from an enclosed graft, comprising:

splitting apart said tube, to form a slot using a slot-forming element; and

removing said graft through said slot.

31. A method according to claim 30, wherein said slot-forming element comprises a knife that splits said tube.

32. A method according to claim 30, wherein said slot-forming element comprises a spreader that widens an existing slit in said tube.

33. A method according to claim 30, comprising:

retracting at least one tube that encloses said graft.

34. A method according to claim 33, wherein said retracting urges said tube against a slot forming element.

35. A method according to claim 30, comprising moving said slot-forming element relative to said tube, to form said slot.

36. An anastomosis connector comprising:

a ring shaped base having an axis;

at least one plurality of spikes on one side of said ring; and

at least one transaxial thickening in at least one of said spikes, distanced from said ring.

37. A connector according to claim 36, comprising a second plurality of spikes pointing in an opposite direction from said first set of spikes.

38. A connector according to claim 36, wherein said thickening comprises a point where said spike splits into tines.

39. A connector according to claim 38, wherein said tines are shorter than a thickness of a target blood vessel for which the connector is designed.

40. A connector according to claim 36, wherein said at least one plurality of spikes do not apply radial pressure towards or away from said ring, once deployed.

41. A method of containing and releasing an anastomotic connector having a thickening, comprising:

containing said connector between two tubes, said thickening being constrained from axial motion by at least one protrusion defined on at least one of said tubes; and

removing at an outer one of said tubes, such that the connector deforms and the thickening is not constrained by said at least one protrusion.

42. A method of performing an anastomosis between a graft and a target vessel, comprising:

inserting an anastomosis connector into the target vessel;

releasing at least one forward spike of said connector;

retracting said connector such that said forward spike engages said target vessel; and

completing said anastomosis.

43. A method according to claim 42, wherein completing said anastomosis comprises releasing at least one backward spike of said connector to engage said target vessel.

44. A method according to claim 42, wherein completing said anastomosis comprises locking said spike to a part of said connector other than said spike.

45. A method according to claim 42, wherein completing said anastomosis comprises releasing said spike to retract towards to a part of said connector other than said spike.

46. A punch mechanism for punching a hole in a blood vessel, comprising:

a sharp tip adapted for puncturing said blood vessel;

a shaft having said tip at one end thereof;

a first widening element distal to said tip ; and

a second widening element distal to said first widening element, said first and second widening elements defining a narrowing between them, which narrowing is adapted to contain a punctured blood vessel wall; and

a coupling element for coupling retraction of said tip with a relative motion of said widening elements, which relative motion is used to contract said narrowing.

47. A punch mechanism according to claim 46, wherein said tip retracts into said first widening, thereby pulling said first widening element towards said second widening element.

48. A punch mechanism according to claim 46, wherein said tip is mounted on a tip-shaft and said tip is retracted by retracting the tip-shaft and wherein said tip shaft is coupled to said shaft, such that after sufficient retraction of said tip shaft, said tip shaft engages said shaft and retracts it.

49. A method of everting a graft, comprising:

grasping said graft between an internal mandrel and an outer tube; and

pushing an end of said graft back over said graft.

50. A method according to claim 49, comprising repeating said pushing a plurality of times to achieve a desired amount of eversion.

51. A method according to claim 49, wherein pushing said end of said graft comprises everting the end over said outer tube.

52. A graft everter, comprising:

a tip adapted for mounting an end of said graft thereon;

a graft stop adapted for stopping an advance of said graft end over said tip; and

a plurality of expanding fingers disposed between said graft stop and said tip, said fingers having an expanded state in which they have an external diameter larger than said tip and larger than said graft and an unexpanded state in which the diameter does not suffice to engage said graft.

53. A method of mounting an anastomosis connector having spikes with tips that bend out of a lumen of said connector, on a graft, comprising:

maintaining said at least some of said spikes in a twisted configuration such that tips of said spikes bend into the lumen;

transfixing said graft on said tips; and

changing the configuration of said tips to bend out.

54. A method according to claim 53, wherein changing the configuration comprises releasing said spikes.

55. A method of simulating eversion of a graft, comprising:
compressing an end of said graft into a form to provide a thickening of said end; and
transfixing said thickening with at least one spike of an anastomosis connector.

56. A method according to claim 55, wherein said graft comprises a mammary artery.

57. A method according to claim 55, wherein said transfixing comprises transfixing along an axis of said graft.

58. A method according to claim 55, wherein said transfixing comprises transfixing oblique to an axis of said graft.

59. A method according to claim 55, wherein said transfixing comprises transfixing perpendicular to an axis of said graft.

60. A method according to claim 55, wherein said form comprises an inner mandrel.

61. A method according to claim 55, wherein said form defines, on said graft, a flat end surface for said thickening.

62. A method according to claim 55, wherein said form defines, on said graft, an oblique end surface for said thickening.

63. A method according to claim 55, wherein said form defines, on said graft, an non-planar end surface for said thickening.

64. A method of transfixing a connector on a graft, comprising:
widening a radius of an end of the graft;
advancing at least one spike of said connector, parallel to said graft, such that it transfixes said widened area; and

bending at least an end of said spike to form a hook.

65. A kit for a bypass procedure, comprising:

at least one graft having anastomosis connectors mounted on two ends thereof, said graft and said connectors adapted for a peripheral bypass procedure; and

at least one guide wire attached to one end of said graft.

66. A kit according to claim 65, wherein said connectors are embedded in said ends of said graft.

67. An oblique hole punch, comprising:

a shaft;

a first non-circular edge oblique to said shaft at a first angle;

a second non-circular edge oblique to said shaft at a second angle; and

means for reducing a gap between said tow edges, so as to cut through vascular tissue placed between them.

68. A punch according to claim 67, wherein said two angles are different.

69. A punch according to claim 67, wherein said two angles are the same.

70. A penetrating punch for punching holes in a blood vessel during a keyhole procedure, comprising:

a tip for puncturing said vessel;

a rigid handle, adapted for keyhole surgery and coupled to said tip, for controlling a spatial position of said tip;

two surfaces for receiving the walls of the vessel surrounding said puncture; and

means for bring said surfaces together for punching said hole.

71. A punch according to claim 70, wherein said tip is smooth.

72. A punch according to claim 70, wherein said tip is axially grooved.

73. A method of heat-treating an anastomosis connector, comprising:

fitting a cut connector into a mold;

fixing said mold to bend both forward and backwards spikes of said connector into a desired configuration; and

heat-treating said fixed connector, thereby training it to said configuration.